

# SYSTEM FOR CONVEYING PACKAGING CUSHIONS

## BACKGROUND OF THE INVENTION

### Field of the Invention

[001] The present invention is to a system for conveying packaging cushions to multiple packing stations. More particularly, the present invention is to a system that automatically and efficiently produces and delivers, monitors and replenishes a string of packaging cushions through an elongated duct into storage bins located above multiple packing stations.

### Description of Related Art

[002] When articles are packaged in a container or box for shipping, there are usually void spaces in the container. Protective packaging material for articles of different sizes and shapes is commonly used to cushion articles during shipping. Numerous types and forms of packaging material for this purpose have been used including waste paper, embossed paper, laminated bubble paper, foamed material and plastic beads. These packaging materials do not always provide the cushioning and void fill most effect to protect articles during shipment. Also, these packaging materials can be costly and often require that a significant amount of labor be performed at the packing station. As a result, thermoplastic cushions have been proposed for use in protecting articles during shipment. One such packaging cushion that has found widespread use is a multiple use inflatable cushion that is specifically designed to be placed around a particular article to be protected and is inflated after the cushion is placed in the shipping container. These types of cushions, while expensive, are particularly useful for the protection of certain types of articles but because each cushion is inflated at the packaging station the packaging process is labor intensive.

[003] However, advantages may be obtained by using simple cellular cushions made of thermoplastic material. Examples of methods of making such cellular cushions are shown in U.S. Pat. Nos. 3,817,803 and 5,340,632. The ability to make these types of cushions simply and at the point of use is of paramount importance. Another example of a device for making cushions is U.S. Patent No. 5,942,076 that describes a machine that includes sealing sheets of thermoplastic material together to form a tube, introducing air to the tubular material and sealing

the ends to make rectangular air-filled cushions of various sizes. The cushion supply machine is located adjacent the product conveyer so that as a container, such as a corrugated box, holding an article to be protected, passes the cushion forming section the operator starts the machine and a series of inflated packaging cushions fall into the container. This system supplies only one packing station at a time.

[004] Once a string of packaging cushions has been formed it is necessary to deliver them to the article packing station. U.S. Pat. No. 6,536,183 discloses a system for delivering packaging cushions to a point of use in which a continuous string of the cushions is fed into an elongated duct with the string extending longitudinally of the duct. An air flow is established in the duct to convey the string of cushions through the duct to the point of use. In U.S. Pat No. 6,428,246 there is disclosed a system and method for making, conveying and dispensing packing material to a packing station. The packaging material is a chain of linked cushions and the system includes a pressurized to an elongated hopper located above a plurality of packing stations. The elongated hopper includes air jets that transfer the string of packaging cushions between each jet to a remote end of the hopper. Located at intervals along the length of the hopper are a series of dispensing openings so the cushions may be accessed at each of the packing stations.

[005] Thus, it is desirable to provide a system capable of efficiently and automatically supplying a string of packaging cushions to be stored in a hopper or bin located at each of multiple packing stations.

#### BRIEF SUMMARY OF THE INVENTION

[006] In accordance with the present invention, in its broadest sense, there is provided a system that automatically delivers, monitors and replenishes packaging cushions to multiple hoppers. In a preferred embodiment the system includes a cushion supply machine that delivers packaging cushions through an elongated duct to hoppers located at multiple packing stations. The elongated cushion delivery duct may have a series of intermediate outlets above the hoppers to permits the string of packaging cushions to drop into the hopper. Each of the hoppers may be located below the delivery duct and above a packing station. A blower is positioned near the inlet of the elongated duct to provide air flow in the duct to carry the string of packaging

cushions through the duct to one of the outlets located above the appropriate packing station whereupon the string of cushions is diverted into the hopper.

[007] In the preferred embodiment, the system includes a knife assembly to cut the string of cushions into lengths that respond to the priority of need in the various hoppers. Prior to the knife cycling to sever the string of cushions, the tension relief gate is held closed, the holding pins are engaged to tension the cushion string for cutting. Now we cycle the knife. The cycling knife stalls air flow momentarily in the duct. The engaged holding pins are not released until the air flow is reestablished to ensure the chain of cushions traveling to the appropriate hopper. The priority of hopper levels, the knife assembly, the tension relief diverter, and the holding pins are controlled by signals from the controller.

[008] Each of the hoppers is automatically monitored and replenished with cushions. When the hopper is full of cushions a sensor signals the controller to close the diverter and the string of cushions is delivered to another packaging station. This is preferably accomplished with a photo eyes in the hopper to send signals to the controller to stop the machine, cut the string of cushions and change the intermediate outlet diverter.

[009] It is therefore, the general object of the present invention to provide a system for delivering packaging cushions to a hopper located at multiple packing stations where the packaging cushions are to be used.

[010] Another object of the present invention is to provide a system that automatically and efficiently produces and delivers, monitors and replenishes a string of packaging cushions through an elongated duct multiple packing stations to a storage bin located above each packing station for easy access and use by a worker.

[011] Other objects, features and advantages of the present invention will become apparent from the following detailed description of the invention taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[012] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein

[013] FIG. 1 is an isometric view of a system for making and delivering packaging cushions to overhead bins located above a plurality of packaging stations according to the present invention;

[014] FIG. 2 is a partial view of the cushion forming machine and the delivery system to a single packing station;

[015] FIG. 3 is an isometric view of a string of packaging cushions attached to each other made by a cushion supply machine;

[016] FIG. 4 is a side view of the system for making, delivering and storing packing cushions to a bin located above a packing station according to the present invention;

[017] FIG. 5 is a side view of the tension release gate in the inlet duct;

[018] FIG. 6 is a side view of the knife assembly located transverse of the duct;

[019] FIG. 7 is a sectional view of the knife assembly used to separate the strings of cushions as the string proceeds through the duct taken along line 7 – 7 of FIG. 6;

[020] FIG. 8 is a sectional view of the holding pins taken along line 8 – 8 of FIG. 6;

[021] FIG. 9A is a side view of the cushion delivery duct illustrating the diverter valve in a closed position at a hopper;

[022] FIG. 9B is a side view of the cushion delivery duct illustrating the diverter valve at the hopper in the open position; and

[023] FIG. 10 is a side view of the cushion delivery duct illustrating a booster blower for assisting a string of cushions through the elongated duct.

#### DETAILED DESCRIPTION OF THE INVENTION

[024] The present inventions now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, these inventions may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

[025] Referring more particularly to the drawings, there is shown in FIG. 1 an overview of a system according to the present invention for making and delivering packaging cushions to multiple packaging stations 40. In a preferred embodiment, a cushion-supply machine 10 makes

a string of packaging cushions 11. The string of cushions is delivered to elongated duct 20. It should be understood that the string of cushions 11 does not have to be delivered directly from a cushion supply machine but may be delivered from other sources. As shown, the elongated duct 20 extends past multiple packing stations 40. The number of packing stations 40 in any particular system will, of course, vary with the volume of articles to be packaged. The elongated duct 20 has a series of intermediate outlets 23 above each hopper 30 for storing the strings of cushions 11. Each of the hoppers 30 is located below the elongated delivery duct 20 and above a packing station 40.

[026] As shown more clearly in FIG. 2, the cushion-forming machine 10 makes a string of packaging cushions that are delivered to elongated delivery duct 20. The elongated delivery duct 20 has an inlet end 21, an outlet end 22, and at least one intermediate outlet 23 between the inlet and outlet ends. The inlet end 21 of delivery duct 20 is capable of receiving the string of packaging cushions. A blower 24 positioned near the inlet 21 of elongated duct 20 provides air flow in the duct to carry the string of packaging cushions through the duct to one of the outlets, such as intermediate outlet 23, located above the appropriate packing station 40 whereupon the string of cushions 11 is diverted through diverter 25 into hopper 30. The hopper or bin 30 may be a mesh basket that holds the cushions 11. Once the hopper 30 that is being filled is sensed as full by sensors 31, preferably photo eyes in the hopper, the system controller 32 stops the cushion production in the cushion supply machine 10, cuts the string of cushions 11, holds the string 11 in the duct 20 until air flow is reestablished, releases the string, then changes the ducting valve path to prepare to send cushions to the next hopper that needs replenishing at a different packing station. The cushion production then continues and the next hopper is filled. As shown, packing operators reach into the overhead hopper 40 through an opening taking a string of cushions to be used in packing the article to be shipped.

[027] A preferred packaging cushion is an air-filled cushion such as the cushions shown in FIG. 3 which illustrate a string of cushions 11 as the string would be being prepared to be placed in a box holding an article for shipping. A preferred cushion supply machine for making the packaging cushions is a Fill Air 1000® inflatable bag making machine available from Sealed Air Corporation. It should be understood that the term packaging cushion also includes foam-filled cushions.

**[028]** As shown more clearly in FIG. 4, a string of cushions **11** is delivered from cushion supply machine **10** to elongated duct **20**. As shown, each cushion of the string of packaging cushions is connected to at least one other adjoining cushion of the string. This string of packaging cushions blown through duct **20** by blower **24** providing air flow at the inlet end of the duct. The length of the string of cushions **11** is predetermined and the string severed at knife assembly **35** located in the horizontal portion of duct **20**, more fully described in FIG. 6. When the knife blade is in the down position severing the string of cushions tension is necessary for a clean cut. Tension is accomplished by using the tension release gate and holding pins. Once severed the string of cushions is carried by the air flow in the duct **20** to the appropriate diverter **25** where the string passes through the opening in the diverter and into the hopper **30**, where the cushions are stored until used. The controller **32** generates a signal to the diverter **25** and a signal to the knife assembly **35** in a coordinated sequence so that cutter blade **39** severs the string of cushions before the diverter **25** adjusts from one position to the other.

**[029]** One aspect of the present invention is to provide a means for applying tension in the string of cushions when the string is separated; that is accomplished through tension-relief gate and holding pins **36**. As shown in FIG. 5, there is provided tension-relief gate **52** located at the inlet end of duct **20**. When activated by a signal from the controller **32**, this mechanism moves tension relief gate **52** against the string of cushions holding the string of cushions in place and serving to relieve the tension on the bag stream during the fill cycle. Without the tension relief gate **52**, the cushion supply machine may produce flat bags. Tension relief gate **52** is coordinated to hold the string of packaging cushions **11** until just before the cushion supply machine's feed cycle. For that purpose a controller **32**, shown in FIG. 4, is adapted to generate the signal in a coordinated sequence. The position of the tension relief gate **52** is controlled by air cylinder **53** operating upon lever **54** in response to a signal from the controller **32**.

**[030]** The length of the string of cushions is determined so that the next string of cushions may be delivered to another bin. The packer, taking a string of cushions out of the bins, decides how long the string needs to be to pack a particular container. The packer simply tears the string of cushions at the perforations between the individual cushions. Such a knife assembly is shown in FIGs. 6 and 7 wherein the knife assembly **35** is placed after the top curve in the horizontal portion of duct **20**. A preferred cutting blade is triangular tooth guillotine blade **39** placed in assembly frame **38**. As shown in FIG. 7, air cylinders **37**, acting in response to a signal from

controller 32 move the blade 39 up and down in frame 38. Of course, other methods of separating, such as tearing at perforations in the area between individual cushions, may be used.

[031] When the knife blade 39 is lowered to sever the string of cushions, the airflow in duct 20 is blocked. The holding pins shown in FIG. 8 are used to maintain the string of cushions 11 above the bottom of the duct 20 until the knife is returned to its upward position and the airflow is reestablished within the duct. Otherwise the air flow over the top of the cushions will hold them to the bottom of the duct and not allow them to move.

[032] As shown in FIGs. 9A and 9B, a diverter 25 in delivery duct 20 and is adapted to move between a diverting position shown in FIG. 9B and a by-pass position shown in FIG. 9A in response to a signal from controller 32, wherein the diverter 25 in the diverting position establishes a first flow path for the string of cushions in the duct from the inlet end 21 through intermediate outlet 23 in the duct 20, and the diverter 25 in the by-pass position blocks the intermediate outlet 23 to establish a second flow path for the string of cushions from the inlet end past the intermediate outlet. The position of the diverter 25 is controlled by air cylinders 26 operating upon lever 27 to move door 28 to the position dictated by the signal from the controller 32.

[033] In systems having a large number of packing stations and consequently a like number of intermediate outlets 23 the elongated duct 20 may extend for some 30 to 40 feet or so. In such cases a substantial amount of the air flow created by blower 24 used to carry the string of cushions is lost through the intermediate outlets 23. When loss of significant air pressure occurs it is difficult for the remaining air flow to carry the string to the intermediate outlets furthest from the inlet end 21 of the duct 20. To overcome this problem a booster blower 33 is provided at an appropriate location in elongated duct 20 as shown in FIG. 10. The booster blower 33 allows the primary blower 24 to exhaust and the booster to make up flow. This allows delivery to the furthest hopper from the inlet duct.

[034] In operation, the system begins by filling each of the bins one after the other in which case the diverter 25 located at each of the intermediate outlets 23 in duct 20 are closed except for the hopper 30 being filled. When the first hopper is filled, the electric eyes sense the level in the hopper and signals the controller 32, which signals the knife assembly 35 to sever the string, and signals the diverter 25 in the duct adjacent the first hopper to close and at the same time open the

diverter in the second hopper. This procedure is continued until each of the hoppers are filled or replenished as the case may be.

**[035]** Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.